

photodiode is analog and the signal transmitted to the processor is digital. The signal conditioner includes an amplifier for amplifying the analog current and an analog-to-digital converter for converting the analog current to the digital signal. Alternately, the signal conditioner is simply an amplifier which amplifies the analog current such that an alarm is triggered when a threshold level is exceeded.

- [0025] One advantage of the present invention is that it incorporates SiC photodiodes, which are reliable for temperatures ≥ 175 ° C.
- [0026] Another advantage of the present invention is that it provides a means for detecting a small number of photons having wavelengths ≤ 250 nm.
- [0027] Another advantage of the present invention is that it provides a low noise detection system.
- [0028] Still further advantages of the present invention will become apparent to those of ordinary skill in the art upon reading and understanding the following detailed description of the preferred embodiments.

Brief Description of Drawings

- [0029] The invention may take form in various components and arrangements of components, and in various steps and arrangements of steps. The drawings are only for purposes of illustrating a preferred embodiment and are not to be construed as limiting the invention.
- [0030] FIGURE 7 illustrates a the device of the present invention within a typical environment.
- [0031] FIGURE 2 illustrates the device of the present invention.
- [0032] FIGURE 3 illustrates a graph showing reflectance vs. wavelength for a Rugate filter according to the present invention.
- [0033] FIGURE 4 illustrates a graph showing current vs. voltage for a SiC photodiode according to the present invention.

Detailed Description

- [0034] With reference to FIGURE 7 , an object 10 (e.g., a missile) is moving toward a target

72 (e.g., an airplane or other mobile or immobile target). A plume 14, which results from missile exhaust, trails behind the missile 10. Ultraviolet (UV) radiation, which is created by fire in the exhaust, is included in the plume 14. The plume 14 and the UV radiation are indicative of a current position of the missile 10. As described in more detail below, the current position of the object 10 is used for determining a distance and direction between the missile 10 and the target 12.

[0035] In general, UV radiation includes wavelengths which extend between a range of about 200 nm to about 400 nm. Solar radiation (i.e., UV radiation from the sun) includes wavelengths within the range of about 250 nm to more than 1 μ m. The wavelengths of UV radiation included within the plume 14 is typically below about 250 nm (i.e., within a range of about 200 nm to about 220 nm).

[0036] A device 20 is used for detecting the UV radiation from the plume 14 or other combustion event of interest, e.g., a fire or explosion. Although the device 20 is illustrated in the preferred embodiment as secured to the target 12, it is to be understood that other embodiments, in which the device 20 is not attached to the target 12 (e.g., is on the ground), are also contemplated. If the plume 14 is set against a background including solar radiation (e.g., a sunlit sky), the device 20 distinguishes between solar UV radiation and UV radiation produced by the exhaust and/or emanating from the plume 14.

[0037] With reference to FIGURES 1 and 2, photons 30 (light), including UV radiation (both solar radiation and UV radiation from the missile exhaust) are incident on the device 20. The device 20 (detector) includes a filter 32 for substantially blocking photons with wavelengths greater than about 250 nm (e.g., about 270 nm), but permitting photons with wavelengths less than about 250 nm to pass. As the graph 34 illustrated in FIGURE 3 shows, the filter 32 in the preferred embodiment provides a rise in reflectance at about the 270 nm wavelength mark. The rise is characterized as from less than about 50% reflectance to more than about 97% reflectance within a span of less than about 3 wavelengths. The filter 32 also provides a cutoff or fall in reflectance at about the 425 nm wavelength mark. The cutoff is characterized as from greater than about 99% reflectance to less than about 50% reflectance within a span of less than about 25 wavelengths. In the preferred embodiment, the filter 32 is a Rugate filter. However, it is to be understood that other filters are also contemplated. Furthermore, the filter 32 preferably includes

inorganic materials (e.g., layers of SiO₂ and Si₃N₄ or SiO₂ and HfO₂) not degraded by temperatures greater than or equal to about 175 °C.

[0038] With reference again to FIGURES 7 and 2, a photodiode 36 is positioned to receive the photons 40 that pass through the filter 32. Preferably, the photodiode 36 is a SiC photodiode. It is to be noted that wavelengths greater than about 400 nm are not detected by the SiC photodiode. Accordingly, responses to solar radiation having wavelengths greater than 400 nm are substantially eliminated. Therefore, when the SiC photodiode is combined with the filter 32, only UV radiation having wavelengths less than about 250 nm are detected. It is presumed then that the detected radiation is emanating from the plume 74 or other combustion event of interest.

[0039] As shown in the graph 38 of FIGURE 4, the photodiode 36 has a low dark current (e.g., less than about 0.4 pA/cm²) and a bandgap of greater than or equal to about 2.7 eV. With reference again to FIGURES 7 and 2, photons 40 that pass through the filter 32 impinge the photodiode 36. A current is produced within the photodiode 36 as a function of the impinging photons 40. More specifically, the current produced within the photodiode 36 is proportional to a quantity of the photons 40, which have wavelengths that are less than or equal to about 250 nm, that pass through the filter 32 and impinge the photodiode 36. A processor 42 determines the quantity of photons 40 impinging the photodiode 36 as a function of the current and determines if non-solar UV radiation (which is assumed to be from a missile plume) exists above a predetermined threshold. An operator of the target 12 is notified when the processor 42 determines non-solar UV radiation exists above the predetermined level. Optionally, the processor 42 determines a distance between the missile 10 and the target 12 as a function of the quantity of photons 40 impinging the photodiode 36.

[0040] The device 20 repeatedly determines the quantity of photons 40 impinging the photodiode 36 (and the distance between the missile 10 and the target 12) at predetermined time intervals. For example, the time interval may be set so that the processor 42 updates the quantity of photons 40 impinging the photodiode 36 in substantially real-time. The processor 42 maintains a historical database of the number of photons 40 impinging the photodiode 36 as a function of the relative positions of the missile 10 and the target 12. In this manner, the processor 42 tracks the closing distance between the object 10 and the target 12. Optionally, an intercepting missile